TECHNICAL MANUAL
OPERATOR'S MANUAL

FOR

RETRO REFLECTOR UNITS (RRUs)

(LOCAL REPRODUCTION AUTHROIZED)

November 1998

FOR INFORMATION ON FIRST AID, REFER TO FM 21-11.

WARNING

MOVING PARTS

ALWAYS be aware of and stand clear of target lifting system and moving parts to include panel targets. Failure to follow this warning may result in injury to personnel.

WARNING

HOFFMAN DEVICE

ALWAYS refer to the Improved Tank Gunfire Simulator (ITGS) (Hoffman Device) operator's manual (see TD 17-6920-702) prior to installing, removing, loading or firing simulator. Failure to follow this warning may result in injury or death to personnel.

WARNING

DO NOT connect or disconnect ITGS (Hoffman Device) to or from target lifter unless target lifter and ITGS power is set to OFF (see TD 17-6920-702) and target lifter battery is disconnected. Failure to follow this warning may result in injury or death to personnel.

TECHNICAL MANUAL
TM 9-6920-703-10

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., *30 November 1998*

TECHNICAL MANUAL
OPERATOR'S MANUAL

FOR

RETRO REFLECTOR UNITS (RRUs)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (*Recommended Changes to Publications and Blank Forms),* or DA Form 2028-2, located in the back of this manual, direct to: Simulation, Training, and Instrumentation Command, ATTN: AMSTI-LL, 12350 Research Parkway, Orlando, FL 32826-3276. A reply will be furnished to you.

TABLE OF CONTENTS

HOW TO USE THIS MANUAL

This manual is designed to help install, remove, and maintain the retro reflector units.

FEATURES OF THIS MANUAL:

- A table of contents is provided at the beginning of most chapters and sections.
- WARNINGs, CAUTIONs, and NOTEs, subject headings, and other important information are highlighted in **BOLD** print as a visual aid.

WARNING

A WARNING indicates a hazard which can result in death or serious injury.

CAUTION

A CAUTION is a reminder of safety practices or directs attention to usage practices that may result in damage to equipment.

NOTE

A NOTE is a statement containing information that will make the procedures easier to perform.

- An alphabetized list of abbreviations and their meaning are included in Chapter 1 for reference purposes.
- Statements and words of particular importance are printed in CAPITAL LETTERS to create emphasis.
- Instructions are located together with illustrations that show the specific task on which the technician is working.
- Equipment locator illustrations are provided throughout the operator and maintenance procedures. These illustrations are for use in locating components and assemblies of the overall equipment.
- Dashed leader lines used in illustrations indicate that called out items are not visible (i.e., they are located within the structure).

FOLLOW THESE GUIDELINES WHEN YOU USE THIS MANUAL:

- An alphabetical index is provided at the end of the manual to assist in locating information not readily found in the table of contents.
- Read through this manual and become familiar with its contents before proceeding to specific operator or maintenance tasks.
- A WARNING SUMMARY is provided at the beginning of this manual and should be read before performing any operator or maintenance tasks.
- In the actual operation or maintenance task, follow all WARNINGs, CAUTIONs, and NOTEs. These are given immediately preceding the procedural steps to which they apply. If these instructions are not followed or care is not taken, injury to personnel or damage to equipment may result.
- Within a chapter, section, or paragraph, headings are used to help group the material and assist you in quickly finding tasks. Read all preliminary information found at the beginning of each task.

CHAPTER 1
INTRODUCTION

1-1. GENERAL.

This manual describes how and where to mount retro reflector units (RRUs) on full scale, 1/2 scale, and 1/10th scale panel targets, as well as on M1 series tanks, M2/M3 Bradley Fighting Vehicles, M113s, HMMWVs, and USMC LAV-25 and AAV vehicles.

1-2. MAINTENANCE FORMS AND PROCEDURES.

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750, *Functional Users Manual for the Army Maintenance Management System (TAMMS)*, as contained in the Maintenance Management Update.

1-3. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIRs).

Let us know if the equipment described in this manual needs improvement. Send us an EIR. As the user, you are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put your comments on an SF Form 368, *Product Quality Deficiency Report*. Mail it to: Simulation, Training, and Instrumentation Command, ATTN: AMSTI-LDT, 12350 Research Parkway, Orlando, FL 32826-3276. We will send you a reply.

1-4. LIST OF ABBREVIATIONS.

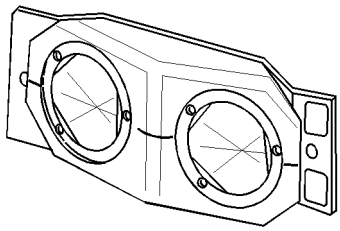
AAV . . . . . Amphibious Assault Vehicle
BFV . . . . . Bradley Fighting Vehicle
CLS . . . . . Contractor Logistic Support
EIR . . . . . Equipment Improvement Recommendation
HMMWV . . . . . High-Mobility Multipurpose Wheeled Vehicle
ITGS . . . . . Improved Tank Gunfire Simulator

1-4. LIST OF ABBREVIATIONS (Con't).

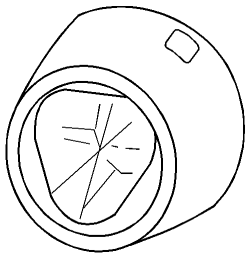
LAV . . . . . Light Armored Vehicle
LTID . . . . . Laser Target Interface Device
MILES . . . . . Multiple Integrated Laser Engagement System
NSN . . . . . National Stock Number
PGS . . . . . Precision Gunnery System
PMCS . . . . . Preventive Maintenance Checks and Services
RRU . . . . . Retro Reflector Unit
TWGSS . . . . . Tank Weapon Gunnery Simulation System

1-5. EQUIPMENT DESCRIPTION.

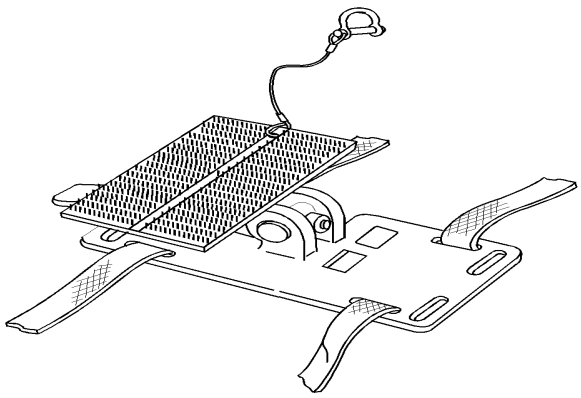
a. **Retro Reflector Unit (Full and 1/2 Scale).** Provides reflections of laser beams back to the TWGSS/PGS-equipped firing vehicle. This enables the firing vehicle to determine range-to-target, impact point determination, and aid during system alignment procedures. Mounted on full and 1/2 scale targets.



b. **Retro Reflector Unit (1/10th Scale).** Provides reflections of laser beams back to the TWGSS/PGS-equipped vehicle. Mounted on 1/10th scale targets.



c. **RRU Mounting Bracket.** Provides an adjustable mounting surface for full scale RRUs to be mounted on a variety of tactical vehicles.



1-6. MATERIAL USED IN CONJUNCTION WITH MAJOR ITEM.

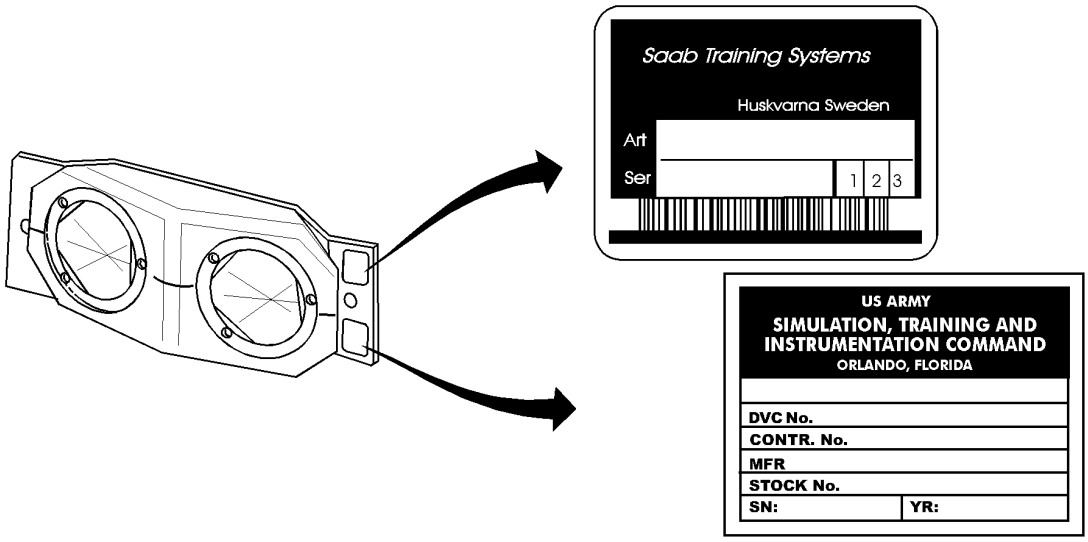
a. **Precision Gunnery System.** The PGS is a vehicle-mounted training device that assists the crew in gaining and improving proficiency in gunnery skills without the expenditure of live ammunition. Gunnery and tactical training can be conducted anywhere that eye-safe laser firing is permitted.

b. **Tank Weapon Gunnery Simulation System.** The TWGSS is a tank-mounted training device that assists the crew in gaining and improving proficiency in gunnery skills without the expenditure of live ammunition. Gunnery and tactical training can be conducted anywhere that eye-safe laser firing is permitted.

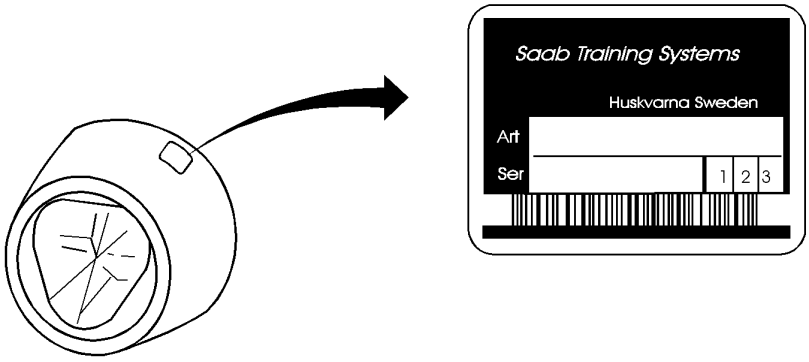
c. **LTIDs/MILES.** Provides interactive training between TWGSS, PGS, and MILES during gunnery and combat training exercises.

1-7. LOCATION AND DESCRIPTION OF DECALS.

a. **Retro Reflector Unit (Full and 1/2 Scale).**

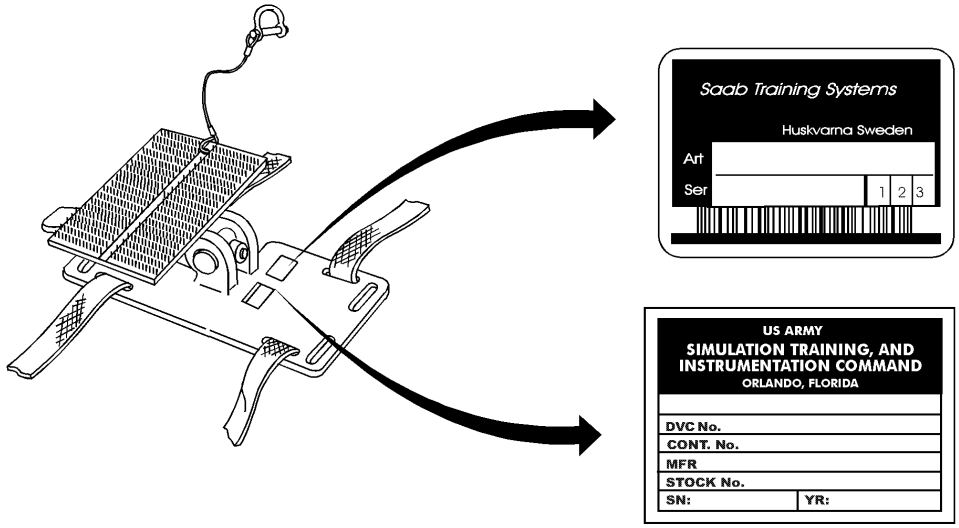


b. **Retro Reflector Unit (1/10th Scale).**

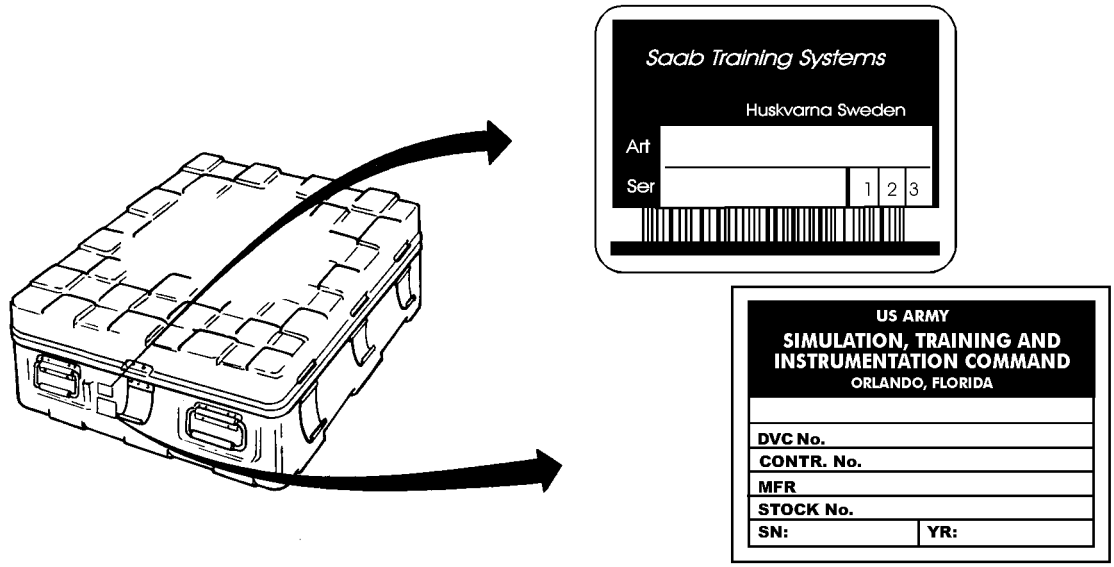


1-7. LOCATION AND DESCRIPTION OF DECALS (Con't).

c. **RRU Mounting Bracket.**



d. **Storage Case.**



1-8. EQUIPMENT DATA.

Retro Reflector Unit (Full and 1/2 Scale):

Length . . . . . 10.2 in. (25.91 cm)
Width . . . . . 4.1 in. (10.41 cm)
Height. . . . . 3.3 in. (8.38 cm)
Weight . . . . . .2 lb (0.91 kg)

Retro Reflector Unit (1/10th Scale):

Diameter . . . . . 1.18 in. (30 mm)
Depth . . . . . 0.98 in. (25 mm)
Weight . . . . . .22 lb (0.1 kg)

RRU Mounting Bracket:

Length . . . . . 9.5 in. (24.0 cm)
Width . . . . . 4.7 in. (12.0 cm)
Height. . . . . 5.3 in. (13.5 cm)
Weight . . . . . 3.1 lb (1.41 kg)

Storage Case (RRUs and Mounting Brackets):

Length . . . . . 33.5 in. (85.09 cm)
Width . . . . . 33.5 in. (85.09 cm)
Height. . . . . 13.6 in. (34.54 cm)
Weights:
- Loaded (Mounting Brackets) . . . . . .115 lb (52.2 kg)
- Loaded (RRUs) . . . . . 90.2 lb (41.0 kg)
- Unloaded . . . . . 37 lb 6 oz (17 kg)

CHAPTER 2
INSTALLATION AND REMOVAL INSTRUCTIONS

2-1. UNPACKING AND PACKING OF COMPONENTS.

a. The retro reflector units (full and 1/10th scale) and mounting brackets are each stored in separate storage cases, 26 per case. The cases are designed to store items as indicated by shaped cutouts in the foam cushioning.

b. An Illustrated Components List is found in Appendix B and on the inside of the storage case lid. Use this illustrated list as a guide when unpacking and packing components.

2-2. PRELIMINARY INSPECTION INSTRUCTIONS.

a. Check all components against the Illustrated Components List, found in Appendix B or on the inside of the storage case lid, to ensure none are missing.

b. Perform *Before* operation Preventive Maintenance Checks and Services (PMCS) (see Chapter 3).

2-3. PREPARATION AND INSTALLATION OF RETRO REFLECTOR UNITS (FULL AND 1/2 SCALE) ON PANEL TARGETS.

NOTE

For LTID installation and operation, refer to TM 9-1265-376-10. In addition, set LTID selections as follows:

- **Set sensitivity to 2-4 km.**
- **Select target type to appropriate setting, depending on panel target used: Infantry, Thin Skin or Armor.**
- **See illustrations for LTID positioning.**

a. **Safety During Target Preparation.** To prevent personal injury and equipment damage, observe the following safety precautions when installing RRUs on panel targets containing lifting devices, LTIDs, and ITGS.

2-3. PREPARATION AND INSTALLATION OF RETRO REFLECTOR UNITS (FULL AND 1/2 SCALE) ON PANEL TARGETS (Con't).

WARNING

- **Always be aware of and stand clear of target lifting system and moving parts to include target panels. Failure to follow this warning may result in injury to personnel.**
- **ALWAYS refer to the Improved Tank Gunfire Simulator (ITGS) (Hoffman Device) operator's manual (see TD 17-6920-702) prior to installing, removing, loading or firing simulator. Failure to follow this warning may result in injury or death to personnel.**
- **DO NOT connect or disconnect ITGS (Hoffman Device) to or from target lifter unless target lifter and ITGS power is set to OFF (see TD 17-6920-702) and target lifter battery is disconnected. Failure to follow this warning may result in injury or death to personnel.**

(1) Place target lifter ON/OFF switch in OFF position (see TM 9-1265-376-10).

(2) Disconnect target lifter battery to ensure that lifter will not be unintentionally raised (see TM 9-1265-376-10).

(3) If used, disconnect ITGS (see TD 17-6920-702).

(4) Ensure that RRUs and LTIDs are securely mounted before lifting target.

(5) Ensure that panel target is securely installed to target lifter (see TM 9-1265-376-10).

b. **Temporary Method of Installation.**

(1) Use aerosol adhesive (Item 1, Appendix C) to attach two pieces of hook velcro (Item 4, Appendix C) to panel target. Velcro should be same size as velcro on RRU.

(2) Place RRU on hook velcro on panel target. Verify that RRU is securely attached.

c. **Permanent Method of Installation.**

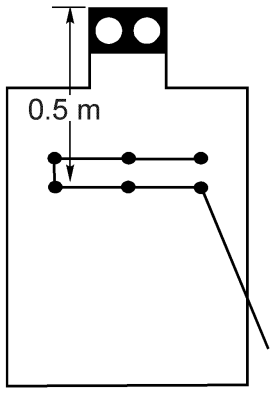
(1) Drill holes in panel target.

(2) Secure RRU to panel target with two bolts and locknuts.

d. **Installation on Type E Infantry Panel Targets (Full and 1/2 Scale).**

(1) Install RRU at top center of panel target (see subparagraphs a thru c).

(2) Ensure that LTIDs are installed in two horizontal groups of three, as shown, 0.5 m (1.64 ft) below top of panel target (see TM 9-1265-376-10).

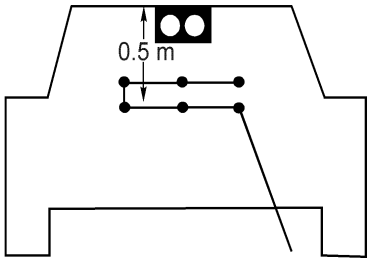


2-3. PREPARATION AND INSTALLATION OF RETRO REFLECTOR UNITS (FULL AND 1/2 SCALE) ON PANEL TARGETS (Con't).

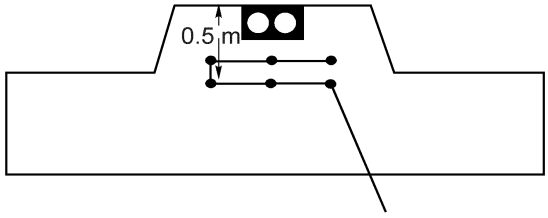
e. **General Panel Targets (Full and 1/2 Scale).**

(1) Install RRU at top center of panel target (see subparagraphs a thru c).

(2) Ensure that LTIDs are installed in two horizontal groups of three, as shown, 0.5 m (1.64 ft) below top of panel target (see TM 9-1265-376-10).



FRONTAL



FLANK

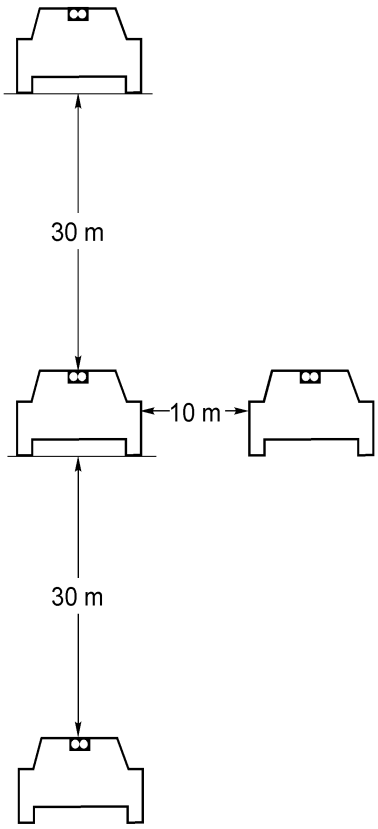
f. **Target Emplacement (Full and 1/2 Scale).**

NOTE

The same target emplacement must be used for full AND 1/2 scale training.

(1) Targets equipped with RRUs must either be laterally dispersed a minimum of 10 m (32.8 ft) between targets or be separated a minimum of 30 m (98.4 ft) in depth between targets.

(2) The same dispersion (between RRU-equipped silhouettes) must be used for groups of Type E infantry panel targets.



2-4. PREPARATION AND INSTALLATION/REMOVAL OF RETRO REFLECTOR UNITS (FULL SCALE) ON VEHICLES.

a. **RRU Installation to Mounting Bracket.**

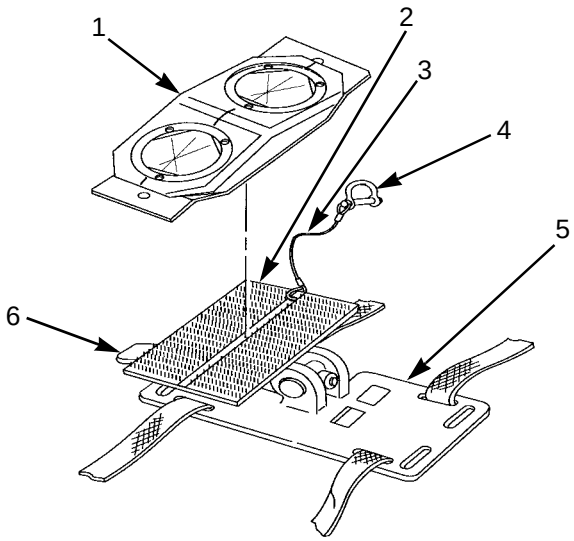
NOTE

Mounting bracket has hook velcro on RRU mounting surface.

(1) Place RRU (1) on mounting surface (2) of mounting bracket (5). Verify that RRU is securely attached.

(2) Attach lanyard (3) to RRU (1) with shackle (4).

(3) Lift locking handle (6) of mounting bracket (5) and rotate mounting surface (2) to position RRU (1).



CAUTION

To prevent damage to RRU during installation on vehicle, ensure that mounting surface is locked. If left unlocked, RRU could pivot out of control and become damaged.

(4) Rotate locking handle (6) to LOCKED position.

b. **RRU Alignment.**

NOTE

To ensure 360 degree coverage of field of view, perform this alignment procedure after each RRU installation.

(1) Install RRU on vehicle (see subparagraphs c thru h).

(2) Lift locking handle (6) of bracket (5).

NOTE

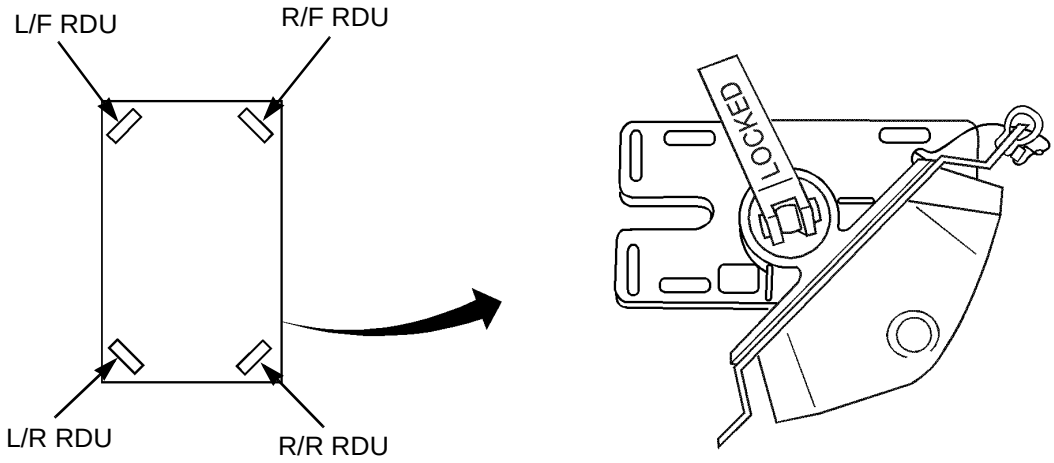
- **Mounting bracket alignment lines are painted in white.**
- **If RRU is installed on vehicle turret, use front/rear or left/right edge of turret for alignment.**
- **If RRU is installed on vehicle hull, use front/rear or left/right edge of hull for alignment.**

(3) Rotate RRU mounting surface (2) until one alignment line (7) is parallel with turret or hull front/rear edge and other alignment line (8) is parallel with turret or hull left/right edge.

(4) Rotate RRU mounting surface (2) until RRU (1) is perpendicular with ground.

(5) Lower locking handle (6) to lock RRU (1) in position.

2-4. PREPARATION AND INSTALLATION/REMOVAL OF RETRO REFLECTOR UNITS (FULL SCALE) ON VEHICLES (Con't).



c. **M1 Series Tank RRU Installation.**

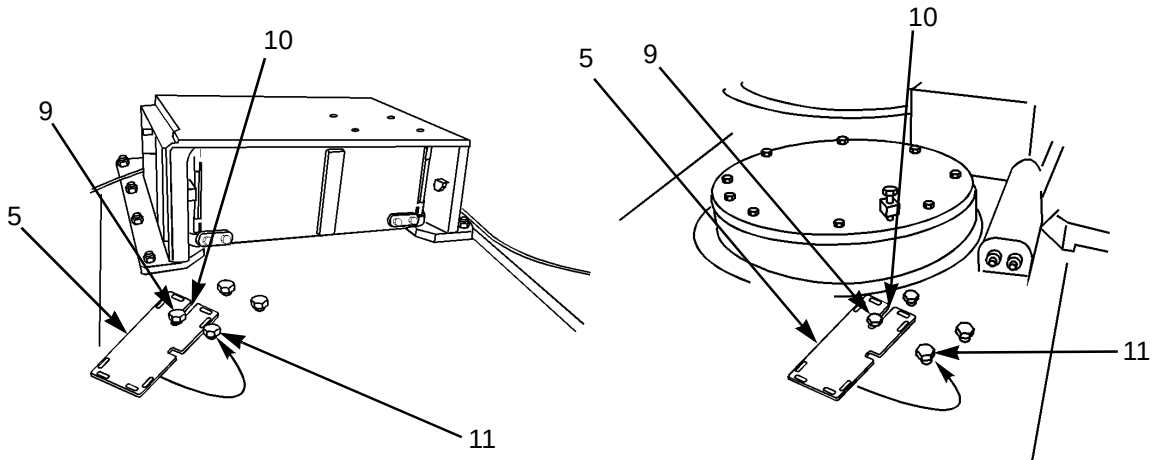
(1) Mount four RRUs on four mounting brackets (see subparagraph a).

(2) Loosen bolt (9) at right- and left-front turret lift points.

(3) Position long end slot (10) of each mounting bracket (5) against bolt (9).

(4) Rotate each mounting bracket (5) against bolt (11).

(5) Tighten bolts (9).



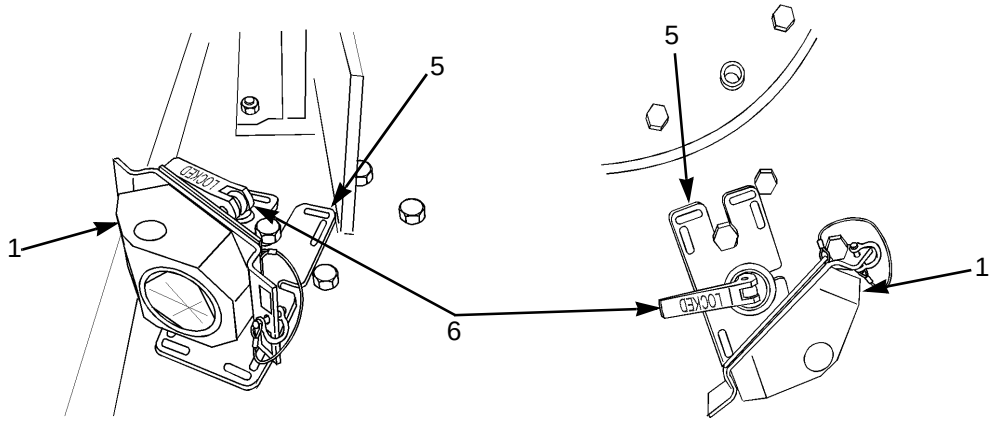
RIGHT-FRONT **LEFT-FRONT**

(RRUs AND MOUNTING SURFACE REMOVED FOR CLARITY)

2-4. PREPARATION AND INSTALLATION/REMOVAL OF RETRO REFLECTOR UNITS (FULL SCALE) ON VEHICLES (Con't).

(6) Lift locking handle (6) of each mounting bracket (5) and rotate RRU (1) into position (see subparagraph b).

(7) Lower locking handle (6) to lock RRU (1) in position.



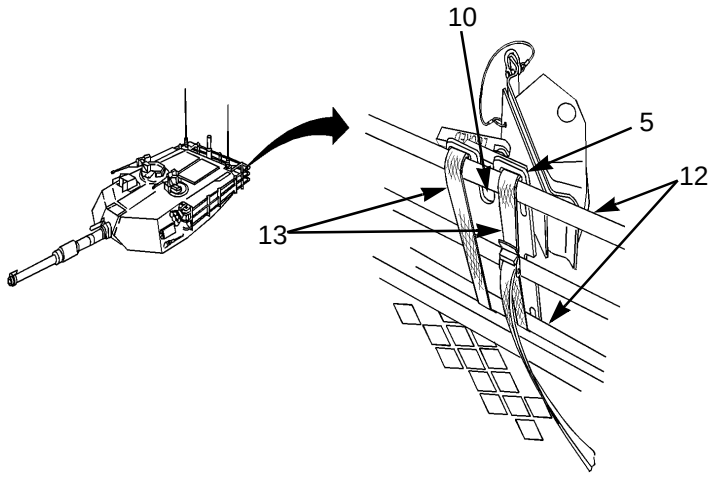
RIGHT-FRONT **LEFT-FRONT**

NOTE

- **Rear RRUs are installed in the same location as TWGSS rear RDUs (see TM 9-6920-709-12&P-1-1 or TM 9-6920-709-12&P-1-2).**
- **Right- and left-rear RRUs are installed the same. Left-rear installation is shown.**

(8) Position mounting bracket (5), with long end slot (10) on top, against upper and lower bustle rack railings (12), to outside of outermost vertical bar on turret bustle rack.

(9) Route straps (13) through bracket end slots and around upper and lower bustle rack railings (12). Tighten straps securely.



LEFT-REAR

2-4. PREPARATION AND INSTALLATION/REMOVAL OF RETRO REFLECTOR UNITS (FULL SCALE) ON VEHICLES (Con't).

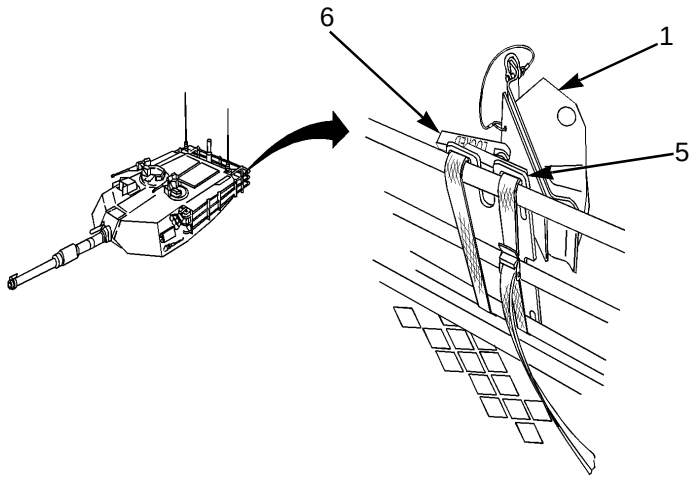
(10) Lift locking handle (6) of each mounting bracket (5) and rotate RRU (1) into position (see subparagraph b).

(11) Lower locking handle (6) to lock RRU (1) in position.

NOTE

When all four RRUs have been installed, the reflective surface of an RRU lens must be visible at all times when you walk around the vehicle.

(12) Walk 360 degrees around vehicle ensuring the reflective surface of an RRU lens is visible at all times. Adjust position of RRUs as required (see subparagraph b).



LEFT-REAR

d. **M2/M3 Series BFV RRU Installation.**

(1) Mount four RRUs on four mounting brackets (see subparagraph a).

NOTE

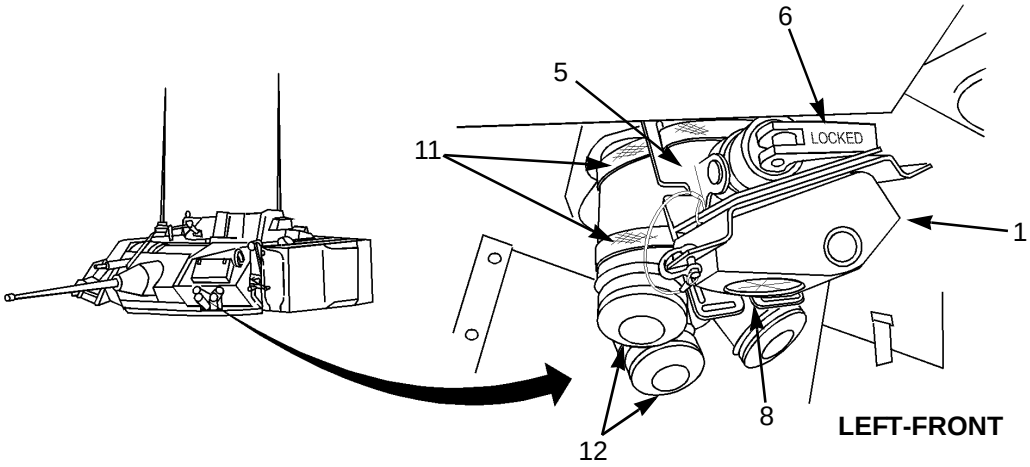
Right- and left-front RRUs are installed the same. Left-front installation is shown.

(2) Position mounting bracket (5), with long end slot (10) forward and centered between two top grenade launcher tubes (14).

(3) Route straps (13) through bracket side slots and around grenade launcher tubes (14). Tighten straps securely.

(4) Lift locking handle (6) of mounting bracket (5) and rotate RRU (1) into position.

2-4. PREPARATION AND INSTALLATION/REMOVAL OF RETRO REFLECTOR UNITS (FULL SCALE) ON VEHICLES (Con't).



(5) Lower locking handle (6) to lock RRU (1) in position.

NOTE

Right-rear RRU is mounted on 2nd ammo box in from the right; left-rear RRU is mounted on left outermost ammo box. Right-rear installation is shown.

(6) Position mounting bracket (5), with long end slot (10) on top, against rear of ammo box (15).

(7) Route straps (13) through bracket end slots and through ammo box (15). Tighten straps securely.

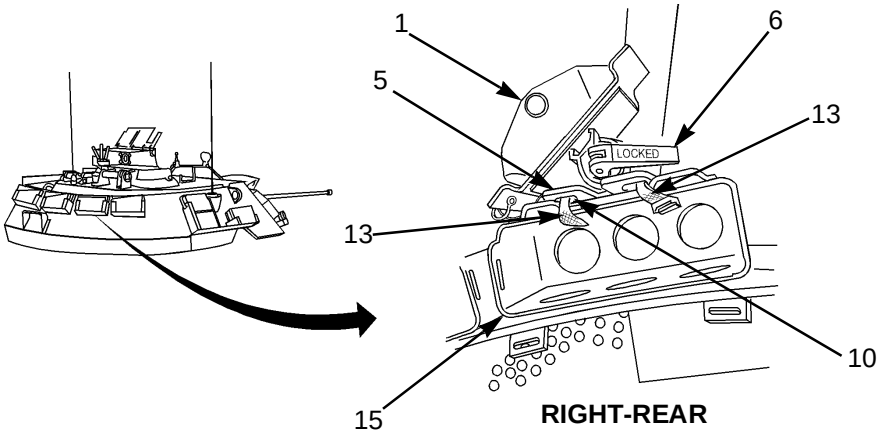
(8) Lift locking handle (6) of each mounting bracket (5) and rotate RRU (1) into position (see subparagraph b).

(9) Lower locking handle (6) to lock RRU (1) in position.

NOTE

When all four RRUs have been installed, the reflective surface of an RRU lens must be visible at all times when you walk around the vehicle.

(10) Walk 360 degrees around vehicle ensuring the reflective surface of an RRU lens is visible at all times. Adjust position of RRUs as required (see subparagraph b).



2-4. PREPARATION AND INSTALLATION/REMOVAL OF RETRO REFLECTOR UNITS (FULL SCALE) ON VEHICLES (Con't).

e. **HMMWV Series RRU Installation.**

(1) Mount four RRUs on four mounting brackets (see subparagraph a).

NOTE

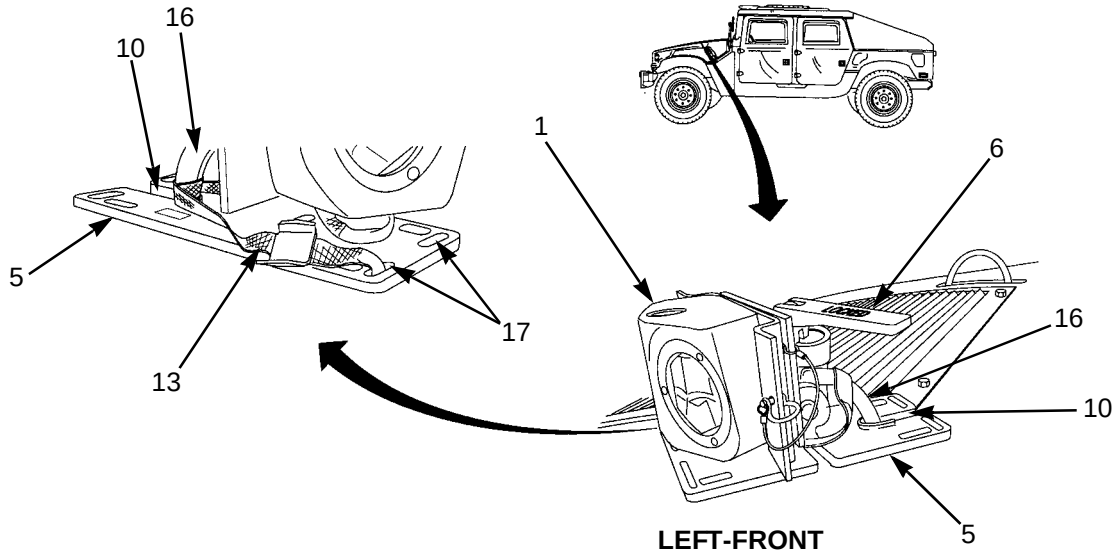
Right- and left-front RRUs are installed the same. Right-front installation is shown.

(2) On outboard side of lifting eye (16), position mounting bracket (5) end slot (10) against lifting eye point closest to windshield. Rotate mounting bracket (5) against forward lifting eye (16) point.

(3) Using one strap (13) looped through inboard and forward most mounting bracket end slot (17), route strap two times around lifting eye (16) point closest to windshield and against hood.

(4) Lift locking handle (6) of each bracket (5) and rotate RRU (1) into position (see subparagraph b).

(5) Lower locking handle (6) to lock RRU (1) in position.



LEFT-FRONT

NOTE

Right- and left-rear RRUs are installed the same. Left-rear installation is shown.

(6) Position mounting bracket (5), with long end slot (10) on top, against outermost end of tailgate (18), to outside of tailgate hinge. Top edge of mounting bracket should be even with top edge of tailgate.

NOTE

Tailgate must be opened to perform step 7.

(7) Route straps (13) through bracket end slots and around tailgate (18). Tighten straps securely. Close tailgate.

(8) Lift locking handle (6) of mounting bracket (5) and rotate RRU (1) into position.

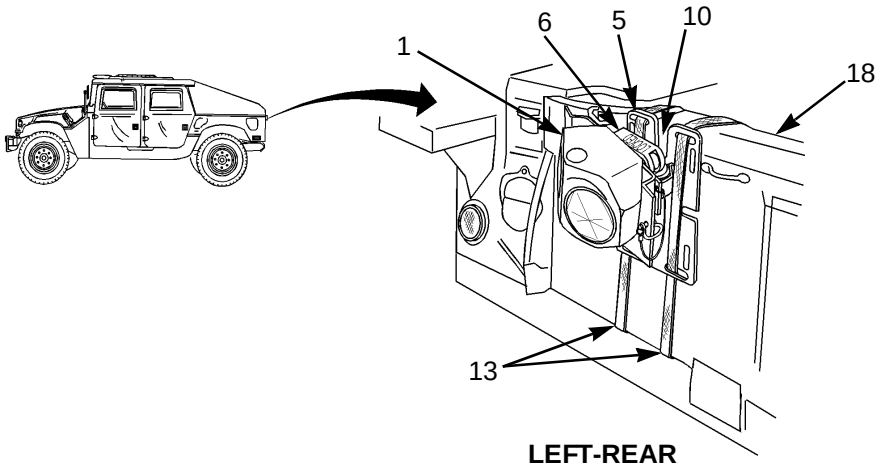
(9) Lower locking handle (6) to lock RRU (1) in position.

NOTE

When all four RRUs have been installed, a reflective surface of an RRU lens must be visible at all times when you walk around the vehicle.

2-4. PREPARATION AND INSTALLATION/REMOVAL OF RETRO REFLECTOR UNITS (FULL SCALE) ON VEHICLES (Con't).

(10) Walk 360 degrees around vehicle ensuring a reflective surface of an RRU lens is visible at all times. Adjust position of RRUs as required (see subparagraph b).



LEFT-REAR

f. **M113 Series RRU Installation.**

(1) Mount four RRUs on four mounting brackets (see subparagraph a).

NOTE

Right- and left-front RRUs are installed the same. Left-front installation is shown.

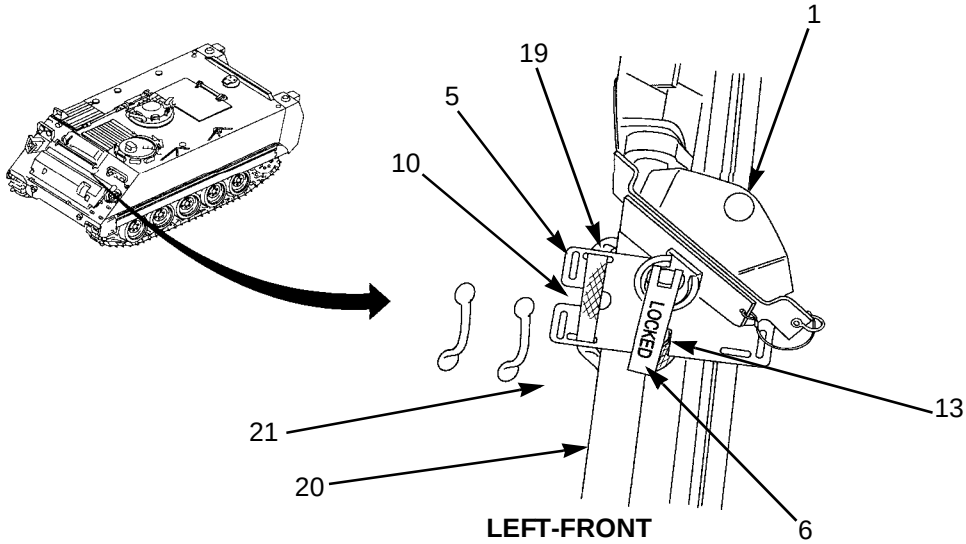
(2) Position mounting bracket (5) on engine compartment door hinge tube (20) with bracket end slot (10) against engine compartment door (21).

(3) Route strap (13) through bracket side slots (19) closest to engine compartment door (21).

(4) Route strap (13) under hinge tube (20), across top of mounting bracket (5), and back under hinge tube (20). Tighten strap securely.

(5) Lift locking handle (6) of each bracket (5) and rotate RRU (1) into position (see subparagraph b).

(6) Lower locking handle (6) to lock RRU (1) in position.



LEFT-FRONT

2-4. PREPARATION AND INSTALLATION/REMOVAL OF RETRO REFLECTOR UNITS (FULL SCALE) ON VEHICLES (Con't).

NOTE

Right- and left-rear RRUs are installed the same. Left-rear installation is shown.

(7) Position mounting bracket (5) along top of taillight bracket (22), with long end slot (10) facing toward middle of vehicle.

(8) Route straps (13) through side slots in mounting bracket (5) in such a manner that bracket does not move when straps are tightened around taillight bracket (22). Tighten straps securely.

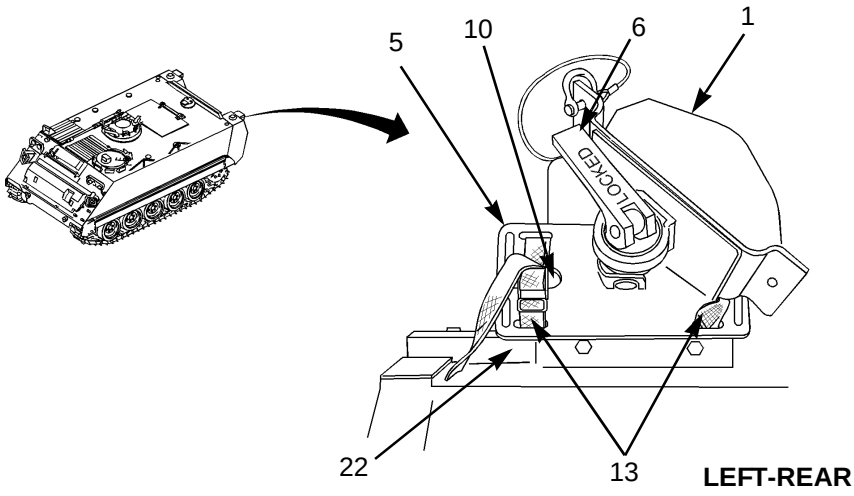
(9) Lift locking handle (6) of mounting bracket (5) and rotate RRU (1) into position.

(10) Lower locking handle (6) to lock RRU (1) in position.

NOTE

When all four RRUs have been installed, a reflective surface of an RRU lens must be visible at all times when you walk around the vehicle.

(11) Walk 360 degrees around vehicle ensuring a reflective surface of an RRU lens is visible at all times. Adjust position of RRUs as required (see subparagraph b).



LEFT-REAR

g. **<u>LAV RRU Installation</u>.**

(1) Mount four RRUs on four mounting brackets (see subparagraph a).

NOTE

Right- and left-rear RRUs are mounted the same on sides of bustle rack. Right-rear installation is shown.

(2) Position mounting bracket (5), with long end slot (10) on top, against midpoint of side of bustle rack (23).

(3) Route straps (13) through bracket end slots (17) and around bustle rack (23) top railing and grille. Tighten straps securely.

(4) Lift locking handle (6) of each mounting bracket (5) and rotate RRU (1) into position (see subparagraph b).

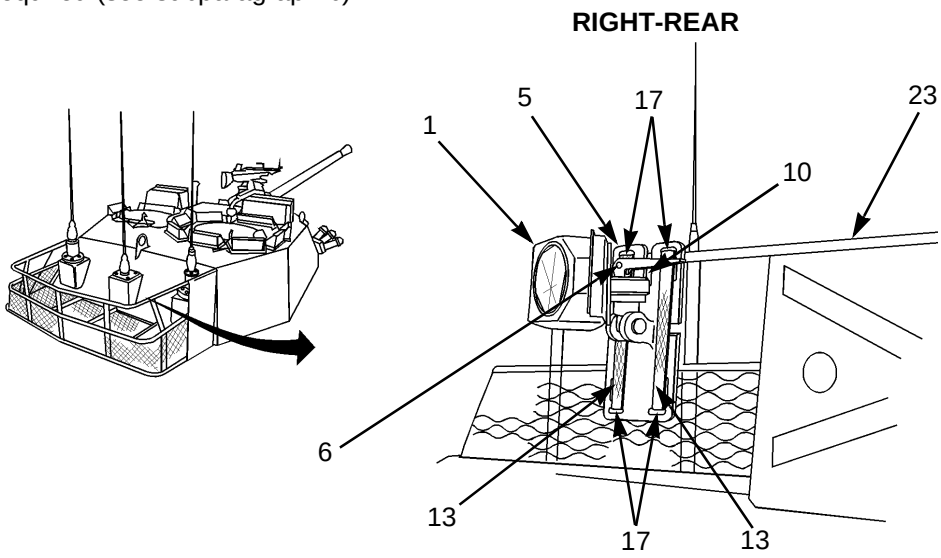
(5) Lower locking handle (6) to lock RRU (5) in position.

NOTE

When all four RRUs have been installed, a reflective surface of an RRU lens must be visible at all times when you walk around the vehicle.

2-4. PREPARATION AND INSTALLATION/REMOVAL OF RETRO REFLECTOR UNITS (FULL SCALE) ON VEHICLES (Con't).

(6) Walk 360 degrees around vehicle ensuring an RRU lens is visible at all times. Adjust position of RRUs as required (see subparagraph b).



h. **AAV RRU Installation.**

(1) Mount four RRUs on four mounting brackets (see subparagraph a).

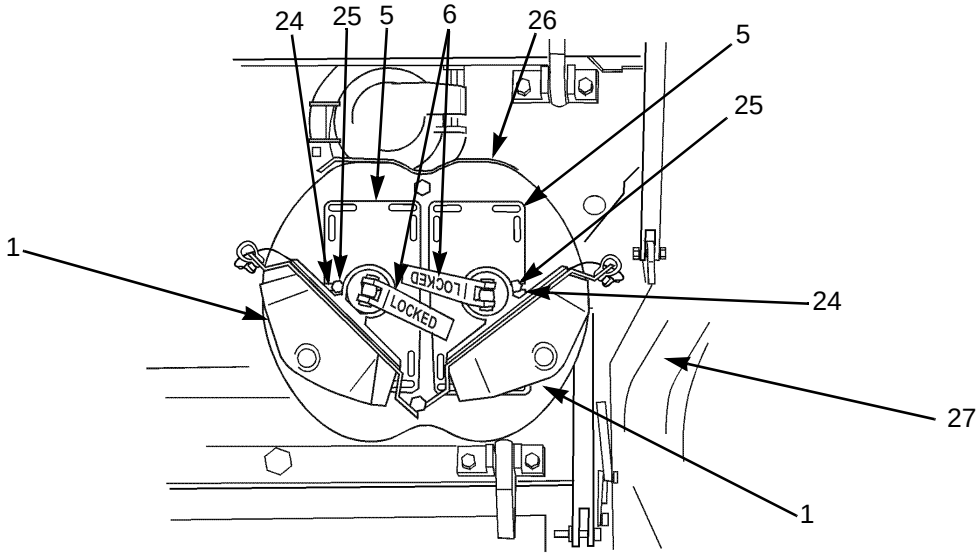
(2) Loosen left and right bolts (25) on aspirator cover (26) next to driver's hatch (27).

(3) Position each mounting bracket (5) side-by-side with RRUs facing forward and bracket slot (24) against bolt (25) on aspirator cover (26).

(4) Tighten bolts (25) against brackets (5).

(5) Lift locking handle (6) on each bracket (5) and rotate RRU (1) into position (see subparagraph b).

(6) Lower locking handle (6) to lock RRU (1) in position.



2-4. PREPARATION AND INSTALLATION/REMOVAL OF RETRO REFLECTOR UNITS (FULL SCALE) ON VEHICLES (Con't).

NOTE

Right- and left-rear RRUs are installed the same. Right-rear installation is shown.

(7) Position mounting bracket (5) on hull weldment (29) next to antenna mount (28).

(8) Route straps (13) through side slots (19) in mounting bracket (5) and around hull weldment (29). Tighten straps securely.

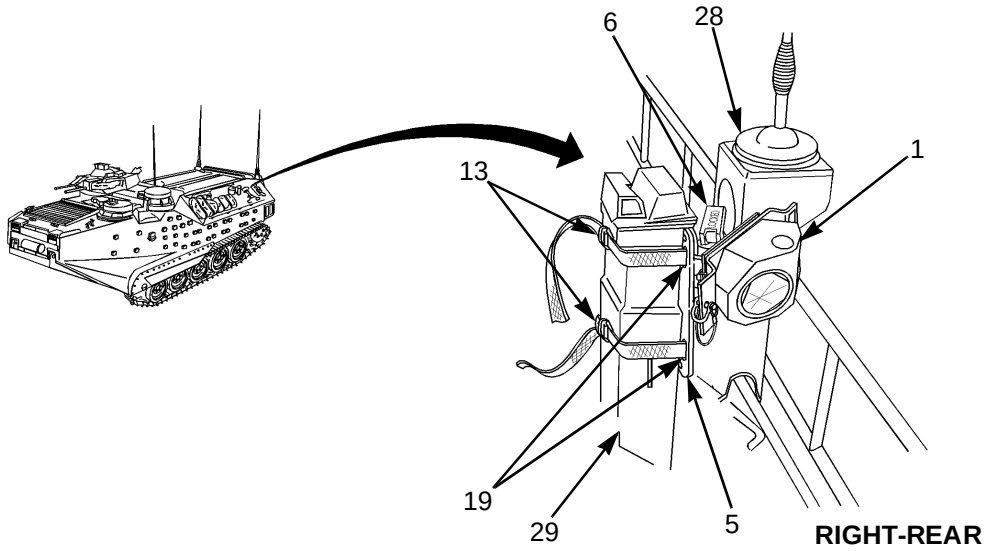
(9) Lift locking handle (6) on each bracket (5) and rotate RRU (1) into position (see subparagraph b).

(10) Lower locking handle (6) to lock RRU (1) in position.

NOTE

When all four RRUs have been installed, a reflective surface of an RRU lens must be visible at all times when you walk around the vehicle.

(11) Walk 360 degrees around vehicle ensuring a reflective surface of an RRU lens is visible at all times. Adjust position of RRUs as required (see subparagraph b).



i. **RRU Removal.**

(1) **M1 Series Tank Front RRU Removal.**

NOTE

Right- and left-front RRUs are removed the same. Right-front RRU is shown.

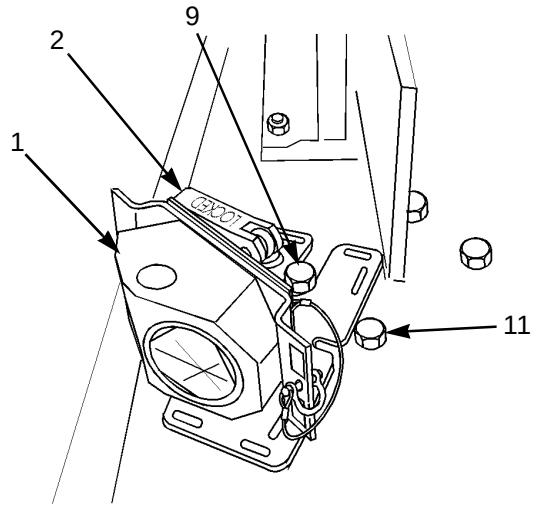
(a) Loosen bolt (9).

(b) Rotate mounting bracket (5) away from bolt (11) and remove.

(c) Fully tighten bolt (9).

2-4. PREPARATION AND INSTALLATION/REMOVAL OF RETRO REFLECTOR UNITS (FULL SCALE) ON VEHICLES (Con't).

(d) Remove RRU (1) from mounting surface (2).



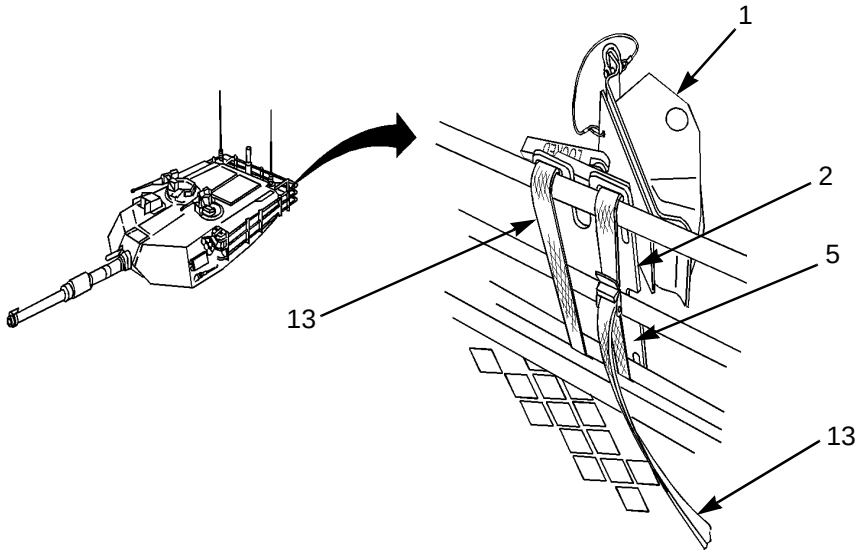
(2) **All Other Vehicles.**

NOTE

M1 Series tank left-rear RRU removal is shown.

(a) Release straps (13) and remove mounting bracket (5) from vehicle.

(b) Remove RRU (1) from mounting surface (2).



2-5. PREPARATION AND INSTALLATION OF RETRO REFLECTOR UNITS (1/10TH SCALE) ON PANEL TARGETS.

NOTE

Strictly follow instructions in TWGSS and PGS manuals (see Appendix A) to ensure successful 1/10th scale gunnery training.

a. **Safety During Target Preparation.** To prevent personal injury and equipment damage, observe the following safety precautions when installing RRUs (1/10th scale) on panel targets.

WARNING

- **Always be aware of and stand clear of target lifting system and moving parts to include target panels. Failure to follow this warning may result in injury to personnel.**
- **ALWAYS refer to the Improved Tank Gunfire Simulator (ITGS) (Hoffman Device) operator's manual (see TD 17-6920-702) prior to installing, removing, loading or firing simulator. Failure to follow this warning may result in injury or death to personnel.**
- **DO NOT connect or disconnect ITGS (Hoffman Device) to or from target lifter unless target lifter and ITGS power is set to OFF (see TD 17-6920-702) and target lifter battery is disconnected. Failure to follow this warning may result in injury or death to personnel.**

(1) Place target lifter ON/OFF switch in OFF position.

(2) Disconnect target lifter battery to ensure that lifter will not be unintentionally raised.

(3) If used, disconnect ITGS (Hoffman Device) (TD 17-6920-702).

(4) Ensure that RRUs are securely mounted before lifting target.

(5) Ensure that panel target is securely installed to target lifter.

NOTE

- **A 1/10th scale RRU allows for a maximum offset of 20 degrees from a perfect head on shot. If angle of attack is to be a maximum of 20 degrees offset, a one-RRU installation, as described in subparagraphs c, d, and e is used.**
- **If angle of attack is to be greater than 20 degrees, a two-RRU installation, as described in subparagraph f, is used.**
- **Perform subparagraph b to determine angle of attack offset.**

b. **Angle of Attack Offset Determination.**

(1) Table 2-1 lists range distances (X) to target, in increments of 10 m. The corresponding maximum allowable offset distance (Y) gives the maximum offset distance that the target can be placed to maintain the angle of attack at a maximum of 20 degrees offset.

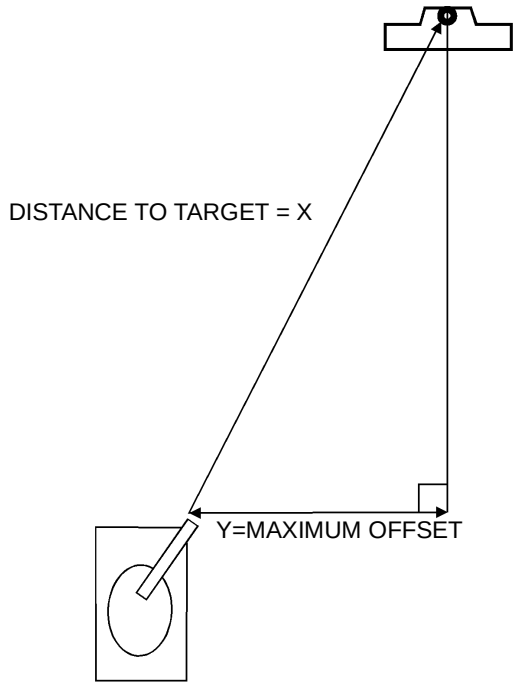
2-5. PREPARATION AND INSTALLATION OF RETRO REFLECTOR UNITS (1/10TH SCALE) ON PANEL TARGETS (Con't).

Table 2-1. Angle of Attack Offset Determination.

Range to Target (X)*	Max. Allowed Offset (Y)**	Range to Target (X)*	Max. Allowed Offset (Y)**
60 m	20 m	160 m	54 m
70 m	24 m	170 m	58 m
80 m	27 m	180 m	61 m
90 m	31 m	190 m	65 m
100 m	34 m	200 m	68 m
110 m	37 m	210 m	71 m
120 m	41 m	220 m	75 m
130 m	44 m	230 m	78 m
140 m	47 m	240 m	82 m
150 m	51 m	250 m	85 m

***** Distance between target and firing vehicle = X
****** Distance between head on attack and battle position = Y

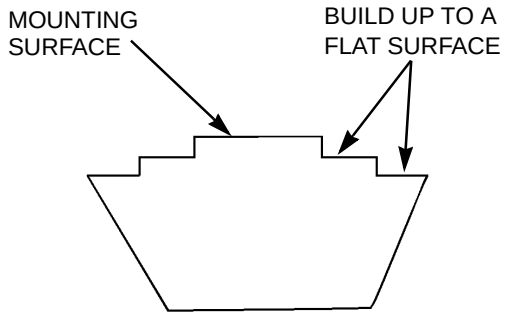
(2) Measure distances X and Y. If distance Y is greater than the values in Table 2-1, either decrease distance Y until it falls within the parameters provided **OR** use a two-RRU installation (see subparagraph f).



2-5. PREPARATION AND INSTALLATION OF RETRO REFLECTOR UNITS (1/10TH SCALE) ON PANEL TARGETS (Con't).

c. **Prepare RRU with Velcro.**

(1) As required, build up back of RRU with a ring of plastic/rubber or cardboard to create a flat mounting surface for the velcro.



(2) Cut enough pile velcro (Item 5, Appendix C) to cover mounting surface of RRU.

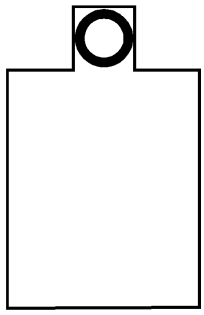
(3) Spray aerosol adhesive (Item 1, Appendix C) on RRU mounting surface and apply smooth side of velcro to adhesive.

d. **Type E Infantry Panel Targets.**

(1) Cut enough hook velcro (Item 4, Appendix C) to receive an RRU.

(2) At top of panel target, spray enough aerosol adhesive (Item 1, Appendix C) to receive velcro. Apply smooth side of velcro to adhesive.

(3) Mount RRU to velcro on panel target.



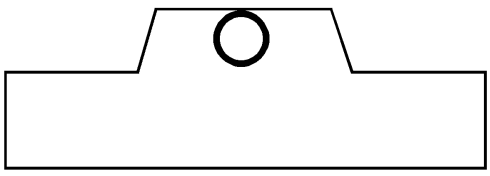
1/10TH SCALE

e. **General Panel Targets.**

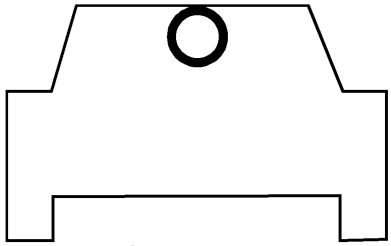
(1) Cut enough hook velcro (Item 4, Appendix C) to receive an RRU.

(2) At top of panel target, spray enough aerosol adhesive (Item 1, Appendix C) to receive velcro. Apply smooth side of velcro to adhesive.

(3) Mount RRU to velcro on panel target.



1/10TH SCALE FLANK



1/10TH SCALE FRONTAL

2-5. PREPARATION AND INSTALLATION OF RETRO REFLECTOR UNITS (1/10TH SCALE) ON PANEL TARGETS (Con't).

f. **Two-RRU Installation.**

NOTE

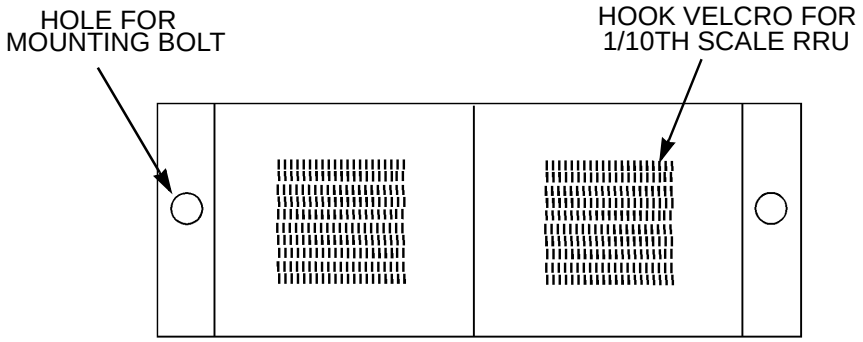
If angle of attack exceeds 20 degrees, two RRUs must be installed on panel target. A two-RRU bracket can be made locally (see Appendix D).

(1) Cut enough hook velcro (Item 4, Appendix C) to receive an RRU.

(2) On bracket, spray enough aerosol adhesive (Item 1, Appendix C) to receive velcro. Apply smooth side of velcro to adhesive.

(3) Mount RRUs to velcro on bracket.

(4) Mount bracket holding two RRUs to panel target with two bolts and locknuts.



g. **Target Emplacement.**

(1) **Target Distance.**

(a) Battle positions must be located a minimum of 60 meters away from any target presented for that battle position, in order for the simulator to register a fire and hit.

(b) Accurately measure line of sight from where gun ends to each target's RRU.

(c) If range includes an offensive engagement, measure distance to target from closest position of engagement.

2-5. PREPARATION AND INSTALLATION OF RETRO REFLECTOR UNITS (1/10TH SCALE) ON PANEL TARGETS (Con't).

(2) **Target Emplacement.**

NOTE

Ensure target emplacement is strictly enforced for 1/10th scale training with TWGSS and PGS. Incorrect target emplacement will cause inaccurate training data.

(a) Targets equipped with 1/10th scale RRUs must either be laterally dispersed a minimum of 10 meters (32.8 ft) between targets or be separated a minimum of 30 meters (98.4 ft) in depth between targets.

(b) If targets are placed closer, ensure that they are NOT presented to crew simultaneously.

(3) **Speed of Moving Targets.**

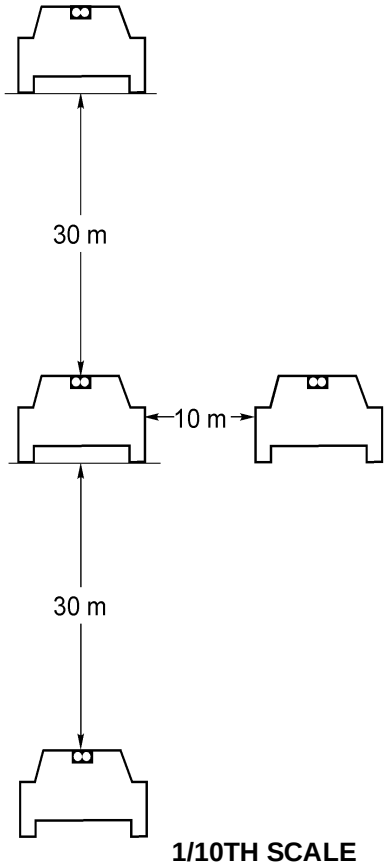
(a) Moving targets must move with 1/10th of normal speed. For instance, if a full scale target speed is 15 mph, the 1/10th scale target speed must be 1.5 mph.

(b) To determine the rate of speed to set the 1/10th scale target:

1. Measure the distance the 1/10th scale target is exposed.

2. Measure the time, using a stopwatch, it takes for 1/10th scale target to move the distance measured in step 1.

3. Use Table 2-2 to determine the rate of speed to set the 1/10th scale target. Adjust 1/10th scale target rate of speed until the desired 1/10th scale target speed is achieved.



1/10TH SCALE

Table 2-2. 1/10th Scale Target Rate of Speed Determination.

Full Scale Target Speed	1/10th Scale Target Speed	1/10th Scale Target Rate of Speed
5 mph	0.5 mph	0.2 m/second
10 mph	1.0 mph	0.4 m/second
15 mph	1.5 mph	0.6 m/second

(4) **Range Proofing.** Proof the range by firing all engagements with TWGSS/PGS.

2-6. PREPARATION FOR STORAGE AND SHIPMENT.

NOTE

The following steps are performed after RRUs have been removed from panel targets or vehicles.

a. Perform *After* operation Preventive Maintenance Checks and Services (PMCS) (see Chapter 3).

b. Store RRUs and mounting brackets in their respective storage cases (see paragraph 2-1).

c. Ensure all storage case latches are securely fastened.

d. Do not stack storage cases more than four high during shipment.

CHAPTER 3
OPERATOR/CREW MAINTENANCE INSTRUCTIONS

3-1. GENERAL.

To ensure a retro reflector unit (RRU) and its related components are ready for use, they must be inspected and serviced. Table 3-1 contains instructions on inspecting and servicing to be performed by Operator/ Crew Maintenance.

3-2. EXPLANATION OF TABLE ENTRIES.

a. **Item Number (Item No.) Column.** Numbers in this column are for reference. When completing DA Form 2404 *(Equipment Inspection and Maintenance Worksheet)*, include the item number for the check/service indicating a fault. Item numbers also appear in the order that you must perform checks and services for the interval listed.

b. **Interval Column.** This column tells you when you must perform the procedures in the procedures column.

(1) *Before* procedures must be done before you use the equipment for its intended mission.

(2) *During* procedures must be done while you use the equipment.

(3) *After* procedures must be done immediately after you have used the equipment.

c. **Location, Item to Check/Service Column.** This column identifies the location and the item to be checked or serviced. The item location is underlined.

d. **Procedures Column.** This column gives the procedures you must perform to check or service the item listed in the Item To Check/Service column to know if your equipment is ready or available for its intended mission. You must perform the procedures at the time stated in the interval column.

e. **Not Fully Mission Capable If: Column.** Information in this column tells you what faults will keep your equipment from being capable of performing its primary mission. If you make check and service procedures that show faults listed in this column, do not use the equipment. Follow standard operating procedures for maintaining the equipment or reporting equipment failure.

3-3. GENERAL PMCS PROCEDURES.

a. Perform PMCS on the equipment in accordance with Table 3-1.

b. Report problems on DA Form 2404 to Training Support Center (TSC).

c. Before performing preventive maintenance, read all the checks required for the applicable interval and have several clean rags (Item 7, Appendix C) handy. Perform ALL inspections at the applicable interval.

3-3. GENERAL PMCS PROCEDURES (Con't).

(1) **Rust and Corrosion.** Check metal parts for rust and corrosion. If any bare metal or corrosion exists, clean and apply a coat of CLP (Item 2, Appendix C). Report it to your supervisor.

(2) **Keep Mounting Brackets Lubricated.** If moving parts of brackets are not lubricated, components could break or wear prematurely. Apply a coat of CLP (Item 2, Appendix C) as required.

(3) **Decals.** Check decals for damage and legibility.

Table 3-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS).

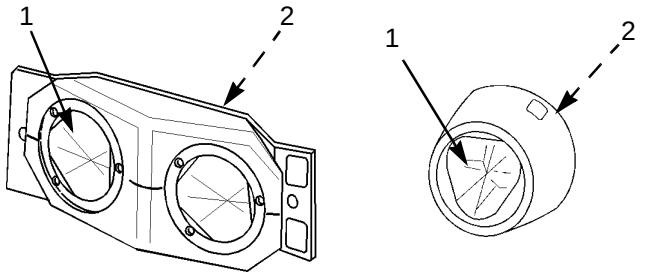
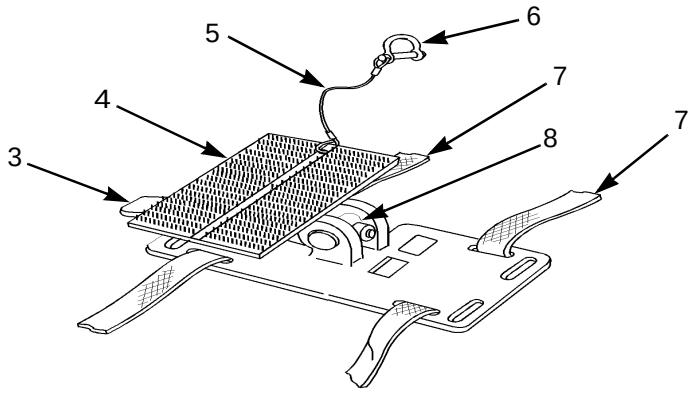
Item No.	Interval	Location: Item To Check/ Service	Procedures	Not Fully Mission Capable If:
1	Before	Storage Case	Check hinges, latches and housing for damage. Check foam interior for dirt or damage. Clean if necessary. Check for moisture. Allow to air dry if necessary.	
2	Before	RRU	a. Check for scratched or broken lens (1). If lens is dirty, gently wipe with lens paper (Item 6, Appendix C) moistened with lens cleaning compound (Item 3, Appendix C).	a. Lens is broken.
			b. Check velcro (2) for tears or other damage.	b. RRU will not adhere to mounting bracket.
				
3	Before	Mounting Bracket	a. Check velcro (4) for tears or other damage.	a. RRU will not adhere to mounting bracket.
			b. Check locking handle (3) and hinge (8) for damage.	b. Locking handle will not lock.
			c. Check for missing or damaged straps (7).	c. A strap is missing or damaged.
			d. Check for missing or damaged lanyard (5) and shackle (6).	d. Lanyard and/or shackle is missing or damaged.
				

Table 3-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS) (Con't).

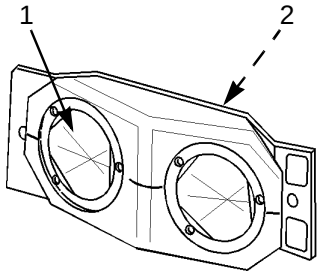
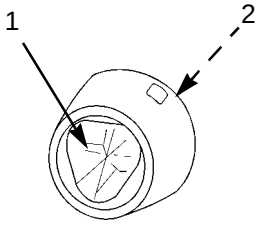
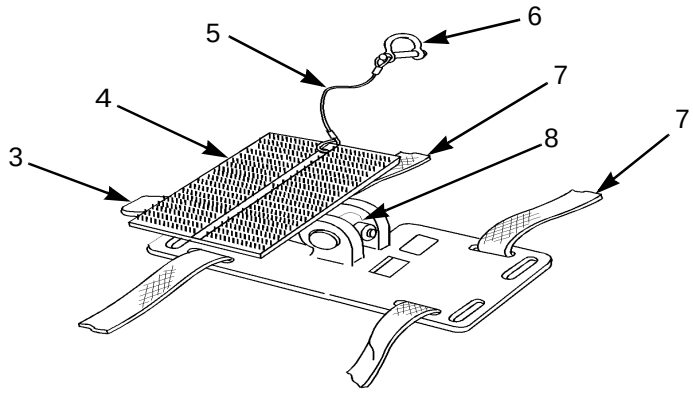
Item No.	Interval	Location: Item To Check/ Service	Procedures	Not Fully Mission Capable If:
4	During	**Mounting Bracket**	Check that straps are securely fastened. Tighten as required. Check that RRU is securely mounted and lanyard is attached. Walk 360 degrees around vehicle ensuring a reflective surface of an RRU lens is visible at all times. Align if necessary (see paragraph 2-4.b)	
5	After	**Storage Case**	Check hinges, latches and housing for damage. Check foam interior for dirt or damage. Clean if necessary. Check for moisture. Allow to air dry if necessary.	
6	After	**RRU**	a. Check for scratched or broken lens (1). If lens is dirty, gently wipe with lens paper (Item 6, Appendix C) moistened with lens cleaning compound (Item 3, Appendix C).	a. Lens is broken.
			b. Check velcro (2) for tears or other damage.	b. RRU will not adhere to mounting bracket.
			 	
7	After	**Mounting Bracket**	a. Check velcro (4) for tears or other damage.	a. RRU will not adhere to mounting bracket.
			b. Check locking handle (3) and hinge (8) for damage.	b. Locking handle will not lock.
			c. Check for missing or damaged straps (7).	c. A strap is missing or damaged.
			d. Check for missing or damaged lanyard (5) and shackle (6).	d. Lanyard and/or shackle is missing or damaged.

Table 3-1. Operator/Crew Preventive Maintenance Checks and Services (PMCS) (Con't).

Item No.	Interval	Location Item To Check/ Service	Procedures	Not Fully Mission Capable If:
7 (Con't)	**After**	**Mounting Bracket**		

CHAPTER 4
MAINTENANCE OF MATERIEL USED IN CONJUNCTION WITH MAJOR ITEM

4-1. PRECISION GUNNERY SYSTEM (PGS).

For information on maintenance of the PGS, refer to TM 9-6920-710-12&P-1 for M2/M3 BFV series and TM 08594A-12&P for LAV-25.

4-2. TANK WEAPON GUNNERY SIMULATION SYSTEM (TWGSS).

For information on maintenance of the TWGSS, refer to TM 9-6920-709-12&P-1-1 for M1/M1A1 series and TM 9-6920-709-12&P-1-2 for M1A2.

APPENDIX A
REFERENCES

A-1. SCOPE.

This appendix lists all forms, technical manuals, and other publications referenced in this manual and that apply to the operation and operator maintenance of retro reflector units (RRUs).

A-2. PUBLICATION INDEX.

DA Pam 25-30, *Consolidated Index of Army Publications and Blank Forms*, should be consulted frequently for latest changes or revisions and for new publications relating to material covered in this technical manual.

A-3. FORMS.

Refer to DA Pam 738-750, *Functional Users Manual for the Army Maintenance Management System (TAMMS)*, for instructions on the use of maintenance forms.

Equipment Inspection and Maintenance Worksheet . . . . . DA Form 2404

Product Quality Deficiency Report . . . . . SF Form 368

Recommended Changes to Equipment Technical Publications . . . . . DA Form 2028-2

Recommended Changes to Publications and Blank Forms . . . . . DA Form 2028

A-4. TECHNICAL MANUALS.

Operator and Organizational Maintenance Manual With Components and Parts List for Precision Gunnery System (PGS) for LAV-25 . . . . . TM 08594A-12&P

Operator's and Unit Maintenance Manual (Including Repair Parts and Special Tools Lists) for Precision Gunnery System (PGS) for M2/M3 BFVs . . . . . TM 9-6920-710-12&P-1

Operator's and Unit Maintenance Manual (Including Repair Parts and Special Tools Lists) for Tank Weapon Gunnery Simulation System (TWGSS) for M1/M1A1 Tanks . . . . . TM 9-6920-710-12&P-1-1

Operator's and Unit Maintenance Manual (Including Repair Parts and Special Tools Lists) for Tank Weapon Gunnery Simulation System (TWGSS) for M1A2 Tank . . . . . TM 9-6920-710-12&P-1-2

Operator’s Manual for Multiple Integrated Laser Engagement System (MILES) Indicator, Simulator System, Laser Target Interface Device (LTID) . . . . TM 9-1265-376-10

A-5. OTHER PUBLICATIONS.

Army Medical Department Expendable/Durable Items . . . . . CTA 8-100

Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items) . . . . . CTA 50-970

First Aid for Soldiers . . . . . FM 21-11

Military Standard Abbreviations for Use on Drawings, Specifications, Standards, and in Technical Documents MIL-STD-12D

Operator's and Organizational Maintenance Manual (With Parts List) for Improved Tank Gunfire Simulator, DVC 17-157 . . . . . TD 17-6920-702

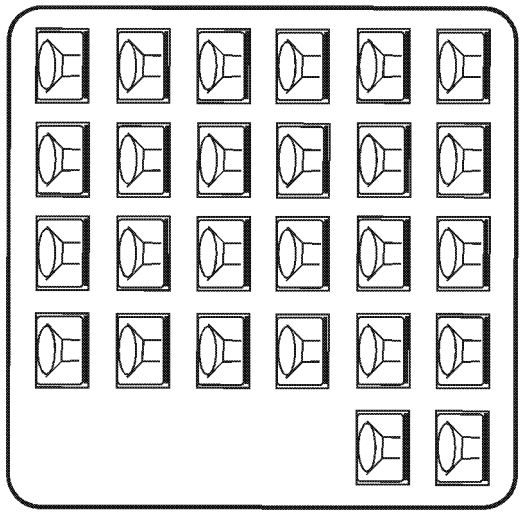
APPENDIX B
ILLUSTRATED COMPONENTS LIST

B-1. SCOPE.

This appendix lists and illustrates full scale retro reflector units (RRUs) and mounting brackets as they are stored in their respective storage cases.

B-2. ILLUSTRATED COMPONENTS LIST.

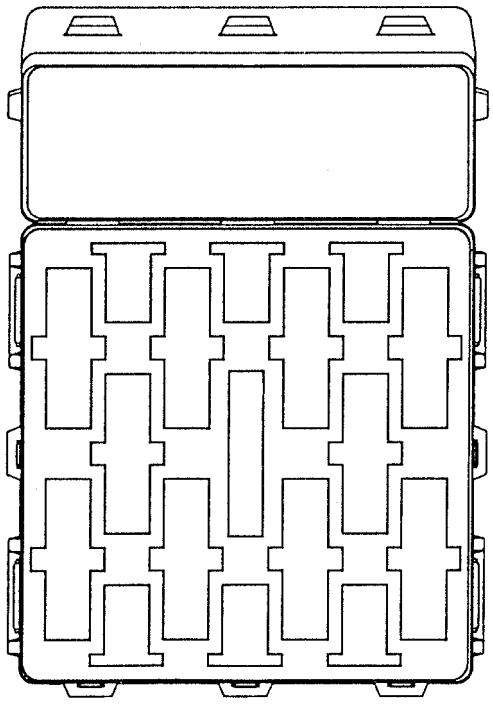
a. **RRU Storage Case.**



Item	Qty	Part Number	Description
1	1	8839110-231	Storage Case
2	26	8835035-101	RRU (Full and 1/2 Scale)

B-2. ILLUSTRATED COMPONENTS LIST (Con't).

b. **RRU Mounting Bracket Storage Case.**



Item	Qty	Part Number	Description
1	1	8854 109-131	Storage Case
2	26	8854 109-211	RRU Mounting Bracket

APPENDIX C
EXPENDABLE AND DURABLE ITEMS LIST

Section I. INTRODUCTION

C-1. SCOPE.

This appendix lists expendable and durable items you will need to mount retro reflector units (RRUs) to panel targets and maintain the RRUs. This listing is for informational purposes only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, *Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items)* or CTA 8-100, *Army Medical Department Expendable/Durable Items.*

C-2. EXPLANATION OF COLUMNS.

a. **Column (1) - Item Number.** This number is assigned to the entry in the listing and is referenced in the "Initial Setup" of maintenance paragraphs or narrative instructions to identify the material needed (i.e., aerosol adhesive, Item 1, Appendix C).

b. **Column (2) - Level.** This column identifies the lowest level of maintenance that requires the listed item.

C. . . . . Unit (Operator or Crew)

c. **Column (3) - National Stock Number.** Identifies the National Stock Number (NSN) assigned to the item.

d. **Column (4) - Description.** Indicates the Federal Item Name and, if required, a description to identify the item. The last line for each item indicates the Commercial and Government Entity Code (CAGEC) in parentheses followed by the part number.

e. **Column (5) - Unit of Measure (U/M)/Unit of Issue (U/I).** The measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in., pr). If the unit of measure differs from the unit of issue as shown in the Army Master Data File (AMDF), requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE AND DURABLE ITEMS LIST

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description (CAGEC) Part Number	(5) U/M U/I
1	C		ADHESIVE: Aerosol (19203) 829899	
		8040-00-262-9028	1 Pint Bottle	pt
2	C		CLEANER: Lubricant, Preservative, PT (CLP) (81349) MIL-L-63460	
		9150-01-054-6453	1 Pint Bottle	pt
3	C		COMPOUND: Cleaning, Optical Lens (30483) 216	
		6850-00-579-8491	1 Pint Bottle	pt
4	C		FASTENER TAPE: Hook (11153) 190559 1 Inch Width, Black	
		8315-01-115-7617	25 Yard Roll	yd
5	C		FASTENER TAPE: Pile (11153) 190427 1 Inch Width, Black	
		8315-01-116-6980	25 Yard Roll	yd
6	C		PAPER: Lens (81349) NNN-P-40	
		6640-00-285-4694	100 Sheets	ea
7	C		RAG: Wiping (64067) 7920-00-205-1711	
		7920-00-205-1711	50 Pound Bale	lb

APPENDIX D
ILLUSTRATED LIST OF MANUFACTURED ITEMS

Section I. INTRODUCTION

a. This appendix includes complete instructions for making items authorized to be manufactured or fabricated.

b. All bulk items needed for manufacture of an item are listed by National Stock Number (NSN) and all dimensions given in both standard and metric units.

Section II. MANUFACTURING INSTRUCTIONS

(1) Cut a piece of aluminum (NSN 9535-01-151-7519, P/N 5052-H32-1/8IN, CAGE 99055) 3 x 7.5 in. (7.62 x 19.05 cm).

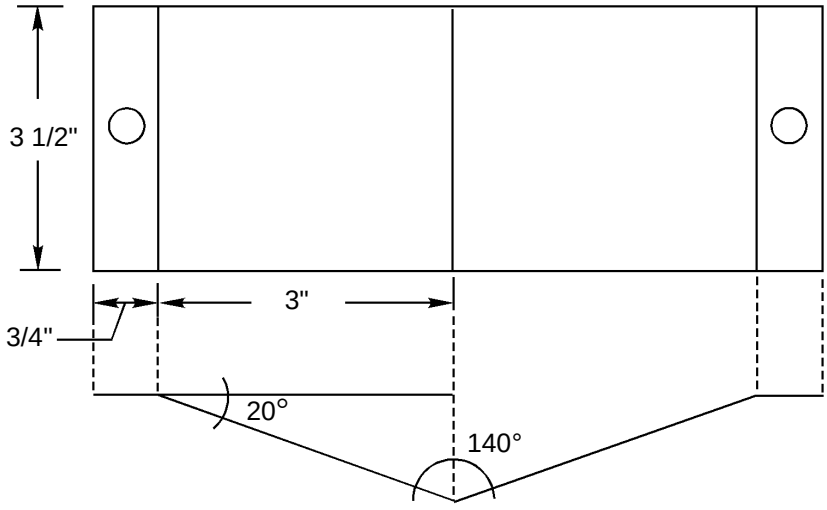
(2) Remove any burrs.

(3) Form a 140 degree bend at center of 7.5 in. length.

(4) Measure in from each end and mark 3/4 in. (1.90 cm).

(5) Make a 20 degree bend at 3/4 in. (1.90 cm) mark on each end.

(6) Drill a 1/4 in. (.64 cm) hole in each end 1.5 in. (3.81 cm) on center.



INDEX

INDEX (Con't)